A Superconducting Electron Linac option for eRHIC

- The parameters of eRHIC may be met by a superconducting linac, with or without a storage ring.
- More effort is necessary to establish the parameters and layout.
- The price of a linac is reasonable – commercially available
- Refrigeration will be provided by the RHIC refrigerator.

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Why a stand-alone linac?

Pros:

- Continuously variable e energy
- Can go to a higher energy
- Better e emittance, important if ions are cooled
- Can use large β at collision point
- Minimal construction inside RHIC tunnel

Cons:

- Fewer collision points
- Challenging technology

The Linac Basic Principles

- The linac cavities will be based on the TESLA design, demonstrated 25 MV/m
- Linac length for a 10 GeV will be of the order of 500 meters.
- Energy recovery of the beam will be done by decelerating the return beam in the linac.

Beam Parameters

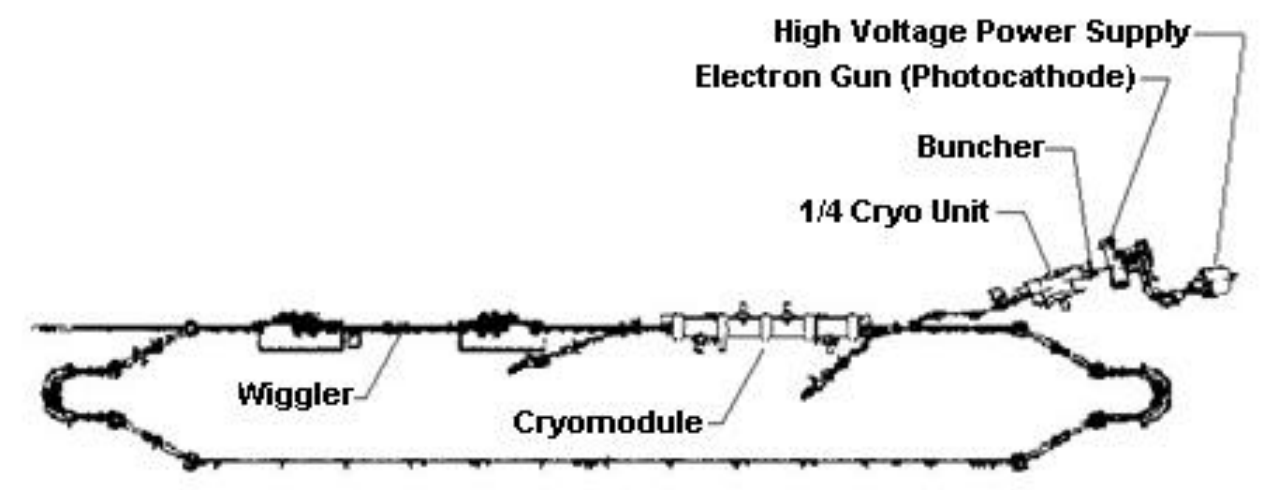
- Pulses of 10^{11} electrons (17 nC) at a repetition rate of approx. 10 MHz. Average current 170 mA.
- Bunch length of the order of 20 picoseconds.
- Emittance is excellent, compatible with large β function and cooled hadron beams

The Source

- Polarized electron gun: GaAs cathode, 80% polarization, quantum efficiency 0.1 to 0.3%
- 1/e lifetime of cathode 10^4 Coul/cm^2. @ 5 cm^2 (7 cm^2 built) and 0.2 A current, lifetime is 2.5×10^5 seconds.
- Laser at 850 nm, about 250 watts. CW diode lasers available.
- Subharmonic bunching to match into linac.

The Linac Basic Principles

- The Jefferson Lab energy recovering linac



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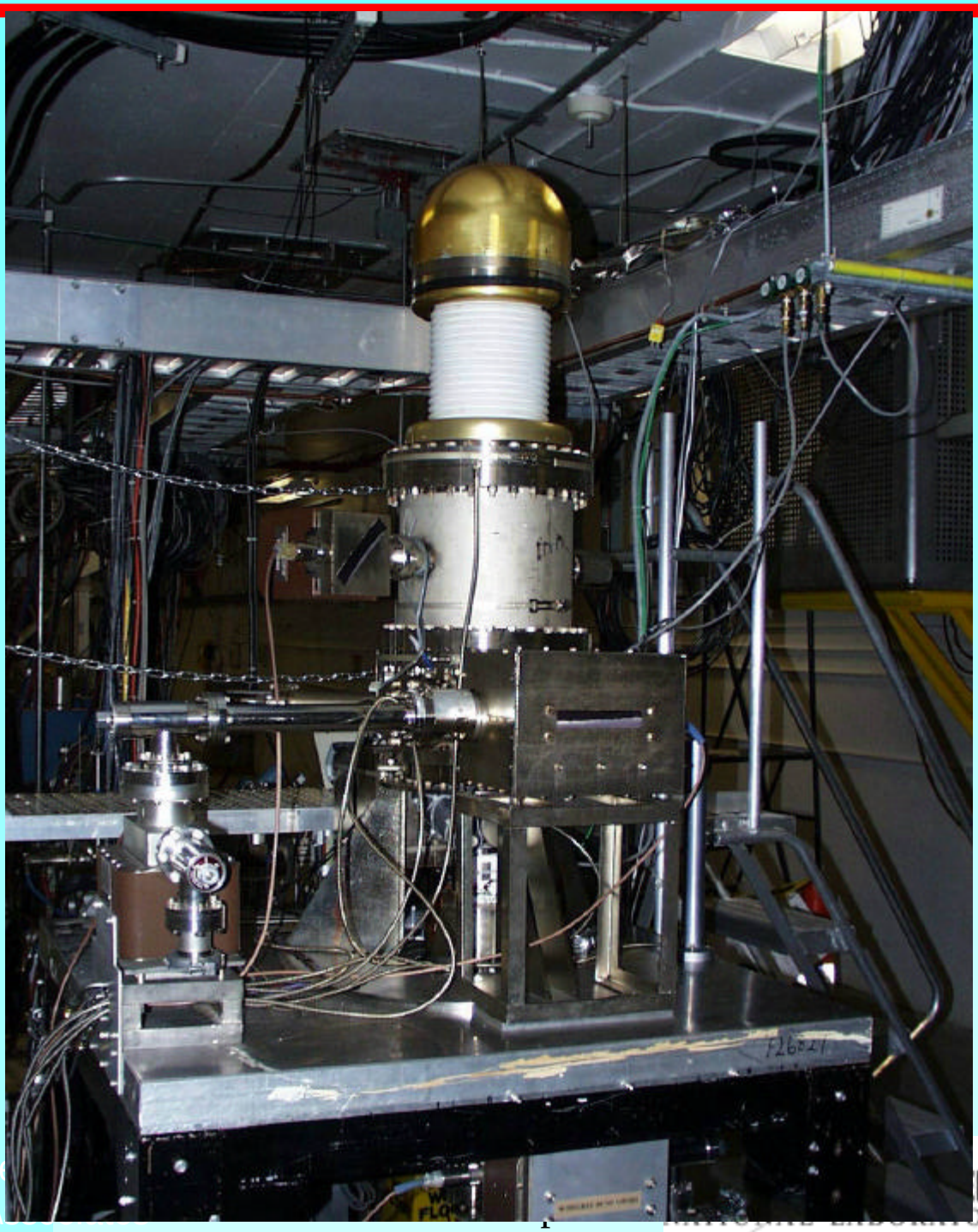
TJNAF Polarized Electron Gun



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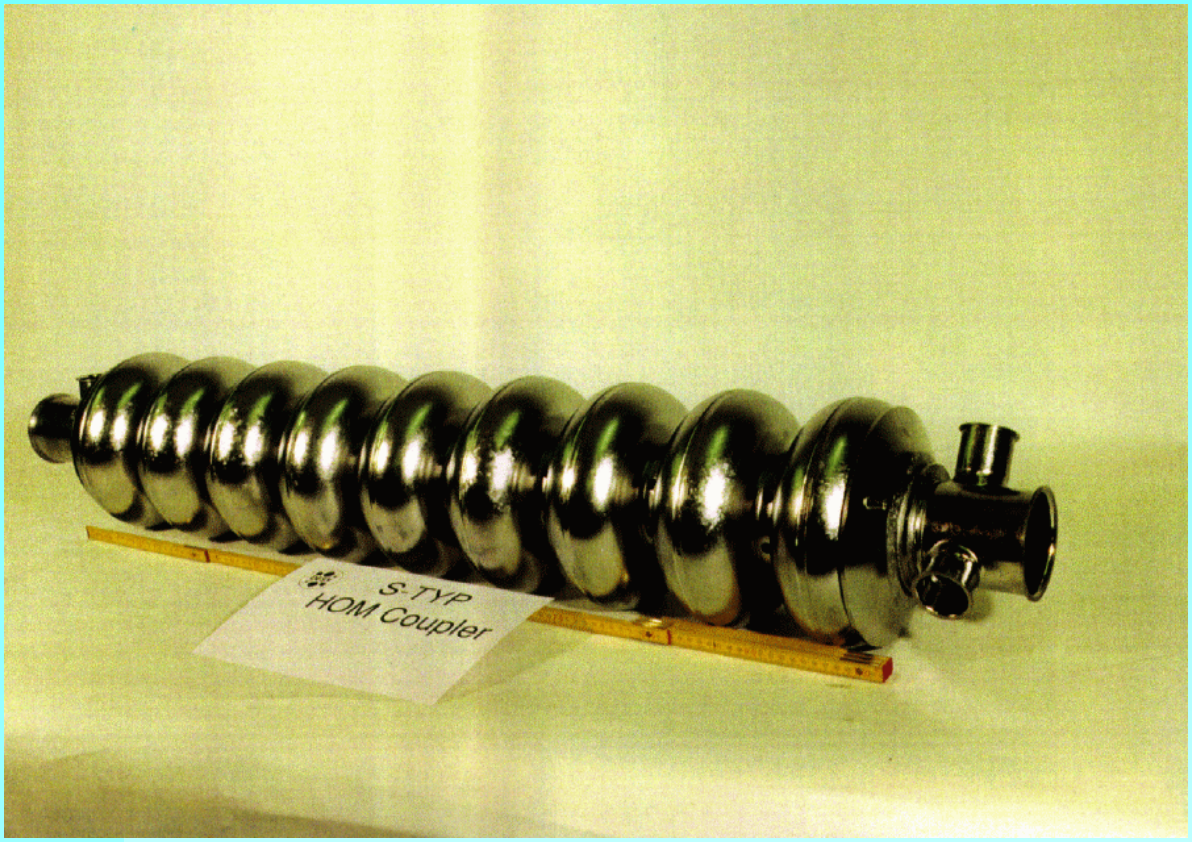
TESLA Accelerator Structure



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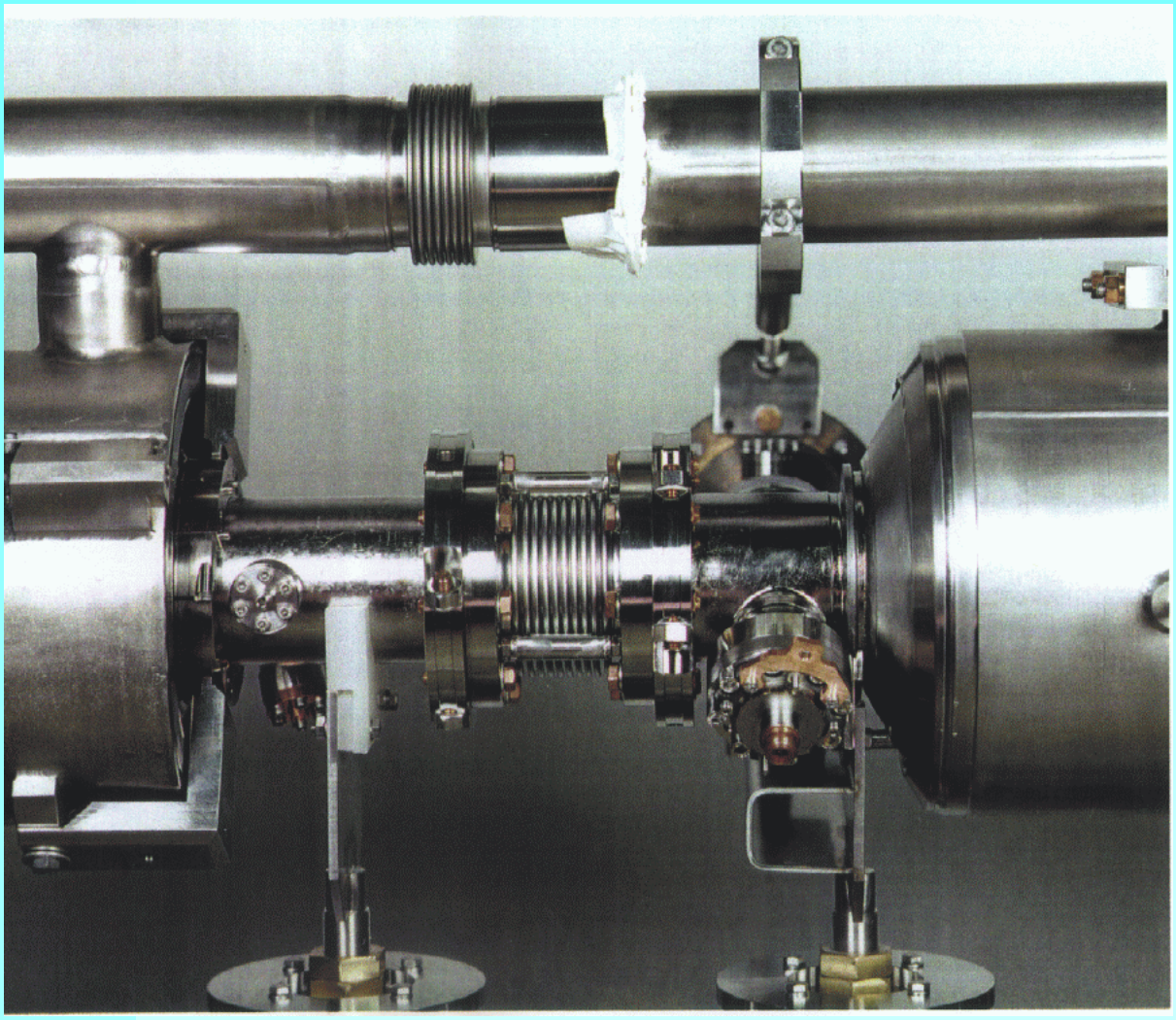
Cavities flanged together



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Beam Stability: Combined function linac

Initial results:

- Multipass Multibunch Instability (30-100 mA) as based on the TJNAF structures (TESLA structures may do better).
- With B-factory style feedback expect large improvement.

Miscellaneous Considerations

- CEBAF Beam Dump is rated at 1 MW. Need to decelerate the beam to about 5 MeV.
- The question of effect of interaction on electron beam has to be studied.